

WHAT IS CLAIMED IS:

- 1 1. A machine-implemented method of processing a sequence of image
2 frames, comprising:
3 computing respective sets of motion vectors for pairs of image frames;
4 classifying the computed motion vectors into motion classes;
5 identifying motion clusters in the image frames based at least in part on the
6 motion classes; and
7 selecting an identified motion cluster as a motion stabilization reference
8 based on spatiotemporal consistency of the selected motion cluster across
9 multiple image frames.
- 1 2. The method of claim 1, wherein computing motion vectors
2 comprises generating for pairs of image frames respective dense motion models
3 describing motion at pixel locations with respective sets of parameter values in a
4 motion parameter space.
- 1 3. The method of claim 2, wherein identifying motion clusters
2 comprises iteratively clustering motion vectors from a coarse image frame
3 resolution level to a fine image frame resolution level.
- 1 4. The method of claim 3, wherein at each image frame resolution
2 level motion vectors are classified into motion clusters, and spatiotemporal
3 consistency is determined for each cluster in a given image frame based on a
4 projection of the motion cluster into a neighboring image frame using computed
5 inter-frame motion
- 1 5. The method of claim 4, wherein the spatiotemporal consistency is
2 determined based on degree of overlap between a motion cluster projected from
3 the given image frame and a corresponding motion cluster in a neighboring image
4 frame.
- 1 6. The method of claim 4, wherein motion vectors are re-classified
2 with a modified clustering parameter in response to a determination that a
3 computed spatiotemporal consistency measure is below a consistency threshold.

1 7. The method of claim 3, wherein motion vectors are clustered
2 iteratively in accordance with a clustering method.

1 8. The method of claim 1, wherein selecting a motion cluster as a
2 motion stabilization reference comprises projecting each motion cluster from
3 image frames to respective neighboring image frames, and computing respective
4 measures of spatiotemporal consistency for the projected motion clusters.

1 9. The method of claim 1, wherein the motion cluster selected as a
2 motion stabilization reference for a given reference image frame has a greater
3 spatiotemporal consistency measure than other motion clusters across multiple
4 image frames neighboring the given reference image frame.

1 10. The method of claim 1, further comprising stabilizing the sequence
2 of image frames with respect to a motion model computed for the motion cluster
3 selected as the motion stabilization reference.

1 11. A system for processing a sequence of image frames, comprising:
2 a motion estimation module configured to compute respective sets of
3 motion vectors for pairs of image frames;
4 a motion classification module configured to classify the computed motion
5 vectors into motion classes;
6 a motion-based spatial clustering module configured to identify motion
7 clusters in the image frames based at least in part on the motion classes; and
8 a motion stabilization reference selection module configured to select an
9 identified motion cluster as a motion stabilization reference based on
10 spatiotemporal consistency of the selected motion cluster across multiple image
11 frames.

1 12. The system of claim 11, wherein the motion estimation module is
2 configured to compute motion vectors by generating for pairs of image frames
3 respective dense motion models describing motion at pixel locations with
4 respective sets of parameter values in a motion parameter space.

1 13. The system of claim 12, wherein the motion-based spatial clustering
2 module is configured to identify motion clusters by iteratively clustering motion
3 vectors from a coarse image frame resolution level to a fine image frame
4 resolution level.

1 14. The system of claim 13, wherein at each image frame resolution
2 level motion vectors are classified by the motion classification module into motion
3 clusters, and spatiotemporal consistency is determined for each cluster in a given
4 image frame based on a projection of the motion cluster into a neighboring image
5 frame using computed inter-frame motion

1 15. The system of claim 14, wherein the spatiotemporal consistency is
2 determined based on degree of overlap between a motion cluster projected from
3 the given image frame and a corresponding motion cluster in a neighboring image
4 frame.

1 16. The system of claim 14, wherein the motion classification module
2 re-classifies the motion vectors with a modified clustering parameter in response
3 to a determination that a computed spatiotemporal consistency measure is below
4 a consistency threshold.

1 17. The system of claim 13, wherein the motion classification module
2 clusters motion vectors iteratively in accordance with a clustering method.

1 18. The system of claim 11, wherein the motion stabilization reference
2 selection module selects a motion cluster as a motion stabilization reference by
3 projecting each motion cluster from image frames to respective neighboring image
4 frames and computing respective measures of spatiotemporal consistency for the
5 projected motion clusters.

1 19. The system of claim 11, wherein the motion stabilization reference
2 selection module selects as a motion stabilization reference for a given reference
3 image frame the motion cluster having a greater spatiotemporal consistency
4 measure than other motion clusters across multiple image frames neighboring the
5 given reference image frame.

1 20. The system of claim 11, further comprising a motion stabilization
2 module configured to stabilize the sequence of image frames with respect to a
3 motion model computed for the motion cluster selected as the motion
4 stabilization reference.

1 21. A machine-readable medium storing machine-readable instructions
2 for causing a machine to:
3 compute respective sets of motion vectors for pairs of image frames;
4 classify the computed motion vectors into motion classes;
5 identifying motion clusters in the image frames based at least in part on the
6 motion classes; and
7 select an identified motion cluster as a motion stabilization reference based
8 on spatiotemporal consistency of the selected motion cluster across multiple
9 image frames.

1 22. The machine-readable medium of claim 21, wherein the machine-
2 readable instructions cause the machine to compute motion vectors by generating
3 for pairs of image frames respective dense motion models describing motion at
4 pixel locations with respective sets of parameter values in a motion parameter
5 space.

1 23. The machine-readable medium of claim 22, wherein the machine-
2 readable instructions cause the machine to identify motion clusters by iteratively
3 clustering motion vectors from a coarse image frame resolution level to a fine
4 image frame resolution level.

1 24. The machine-readable medium of claim 23, wherein at each image
2 frame resolution level motion vectors are classified into motion clusters, and
3 spatiotemporal consistency is determined for each cluster in a given image frame
4 based on a projection of the motion cluster into a neighboring image frame using
5 computed inter-frame motion

1 25. The machine-readable medium of claim 24, wherein the
2 spatiotemporal consistency is determined based on degree of overlap between a

3 motion cluster projected from the given image frame and a corresponding motion
4 cluster in a neighboring image frame.

1 26. The machine-readable medium of claim 24, wherein the machine-
2 readable instructions cause the machine to re-classify the motion vectors with a
3 modified clustering parameter in response to a determination that a computed
4 spatiotemporal consistency measure is below a consistency threshold.

1 27. The machine-readable medium of claim 23, wherein the machine-
2 readable instructions cause the machine to cluster motion vectors iteratively in
3 accordance with a clustering method.

1 28. The machine-readable medium of claim 21, wherein the machine-
2 readable instructions cause the machine to select a motion cluster as a motion
3 stabilization reference by projecting each motion cluster from image frames to
4 respective neighboring image frames and computing respective measures of
5 spatiotemporal consistency for the projected motion clusters.

1 29. The machine-readable medium of claim 21, wherein the machine-
2 readable instructions cause the machine to select as a motion stabilization
3 reference for a given reference image frame the motion cluster having a greater
4 spatiotemporal consistency measure than other motion clusters across multiple
5 image frames neighboring the given reference image frame.

1 30. The machine-readable medium of claim 21, wherein the machine-
2 readable instructions cause the machine to stabilize the sequence of image frames
3 with respect to a motion model computed for the motion cluster selected as the
4 motion stabilization reference.